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AUTHOR Sasser, Linda M.; Keenan, Verne
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ABSTRACT

Age-related improvement of mnemonic performances of children has attracted many investigators wishing to determine developmental mechanisms which might produce this improvement. Potential explanations have been subsumed under three major categories: capacity, strategies, and knowledge structures. The present investigation, in focusing on children's knowledge structures, helps to reveal interactions of inferred structures with various word-processing tasks, and to find possible developmental patterns among these interactions in the years before formal schooling. Ninety-six children attending suburban preschools were selected in equal numbers of boys and girls at ages 3, 4, and 5 years. Within age-gender groups, subjects were randomly assigned to the eight treatment combinations of two word lists and four processing tasks. The tasks were answering autographical questions about the word (i.e., to relate a target word to personal episodes or events in long-term storage), pointing to the category of the word, hearing the words embedded in a story, or repeating the word five times. The list contained three words in each of four categories. Each subject heard and repeated the twelve words, processed them in the assigned manner and, after a brief distractor task, was given tests of free recall, cued recall, and recognition. Results are discussed. (Author/RH)

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MEMORY FOR WORDS PROCESSED BY PRESCHOOL CHILDREN

Linda M. Sasser, and Verne Keenan

University of Colorado

Boulder, Colorado

(Abstract)

Age-related improvement of mnemonic performances of children has attracted many investigators wishing to determine developmental mechanisms which might produce this improvement. Potential explanations have been subsumed under three major categories: capacity, strategies, and knowledge structures. The present investigation focused on childrens knowledge structures, helping to reveal interactions of inferred structures with various word-processing tasks, and to find possible developmental patterns among these interactions in the years before formal schooling. Ninety-six children attending suburban preschools were selected in equal numbers of boys and girls at age 3, 4, and 5 years. Within age-gender groups, they were randomly assigned to the eight treatment combinations of two word lists and four processing tasks. The tasks were answering autographical questions about the word (episodic), pointing to the category of the word (semantic), hearing the words embedded in a story (schematic), or repeating the word five times (repetitive). The list contained three words in each of four categories. Each subject heard and repeated the twelve words, processed them in the assigned manner and, after a brief distractor task, was given tests of free recall, cued recall, and recognition. Repetitive processing produced the best free recall, and episodic processing led to the best cued recall. Repetitive and episodic processing groups showed better recognition than semantic and schematic processing groups. Results were considered in terms of the episodic and semantic stores of very young children, as well as their abilities in understanding cognitive demands of the experimental situations and of their own cognitive processes.

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Since the work of Alfred Binet, at least, it has been known that mnemonic performances of children improve as those children grow older. Explanations for this generalization have begun to unfold only recently as experimental paradigms and theoretical models have been adapted from the study of adult memory to the study of children's memory. Only in the last few years has there been a systematic investigation of memorial processes of preschoolers. The various factors proposed to explain the growth of memory may be classified as capacity, strategy, or knowledge factors.

In the multistore models of information processing (e.g. Atkinson & Shiffrin, 1968), the second stage was characterized as a short-term, limited-capacity store. It was, therefore, the site of selection of items to be copied into permanent memory. Since it was limited in capacity, differences in memorial ability were conveniently attributed to differences in capacity of the short term store, and age differences were seen as not needing further explanation--small bodies have small memories. This simple and direct model was contradicted by a series of investigations by Chi (1976), and most investigators turned their attentions to the acquisition of mnemonic strategies, and the accretion of real-world knowledge.

A substantial body of literature has accrued on the observation of spontaneous mnemonic strategies in children and on a variety of strategy-training procedures (see reviews by Ornstein & Naus, 1978; Lange, 1978; Hagen & Stanovich, 1977; Kobasigawa, 1977; and Moely, 1977). The studies tend to be closely involved with intent to remember and other metamemory variables (see Flavell & Wellman, 1977),

and are important primarily for their descriptions of memory in school-age children. Because of the presumption that strategies can be taught, there is a focus of attention on training models for school children at varying ages and for children from special school populations (Lines & Keenan, Note 1; Asarnow & Meichenbaum, 1979). For very young children, however, the factor revealed as most promising is the knowledge factor. Concerning these children, Myers and Perlmutter (1978) tell us " . . . recognition is good, recall poor, and both improve between two and five. Further, even at the youngest ages we would characterize memory as knowledge dependent, but even at the oldest ages, as nonstrategic." The present investigation was planned to explore a variety of inferred knowledge structures of preschool children, particularly as those structures interact with mnemonic processing.

Alternative models of the contents of long-term memory include the episodic-semantic distinction drawn by Tulving (1972). While that distinction has been quite useful in guiding investigation of memory in young adults, it is clearly inadequate for the partition of the contents of memories of children just acquiring language. It is obvious that children who are three to five years old understand conceptual categories. It is equally obvious that some of this knowledge is linguistic and (and may properly be called semantic) while much of it is not yet linguistically coded. A child knows that her coat is the blue one long before she knows "blue" as a word, i.e. as a semantic element. Because knowledge abstracted from many occasions seems not to fit convincingly the episodic classification, Hintzman (1978) discusses episodic and generic memories rather than use

Tulvings term, "semantic." Nelson and Brown (1978), on the other hand, have included recurring as well as discrete event sequences in episodic memory. The present study adopts the Nelson and Brown usage of episodic to refer to personal or autographical experiences, whether isolated or recurring events. Semantic memory will be restricted to category membership. A further distinction is made for event sequences which are relationally or procedurally similar, and memory for such sequences will be called schematic. There appear to be no studies of childrens schematic memory, as such, except the scripts which have been inferred from infant diaries. Nelson (1978) reports scripts, inferred from interviews with nursery school children, indicating that children store the abstract sequence of events associated with eating a meal at school or a meal at MacDonalds. Since children have demonstrated their anticipation of events in common sequences, and have heard stories read to them which have dependable patterns, it is presumed that the lexical elements of a story can be cued by the memory for the gist of the story. In episodic, semantic, and schematic ways, then, children may be expected to use the material stored in permanent memory to cue particular words for retrieval. Furthermore, the nature of the contents of memory may be tentatively inferred from the retrieval performances of children given appropriate list processing tasks. The purpose of this investigation was to provide such tasks, appropriate to the inferred stores, and to trace the relative cueing power of the tasks in the ages from three to five years.

Method

Subjects and design

Ninety-six children were drawn from preschools and daycare centers in middleclass suburbs of Denver. All subjects were within four months, plus or minus, of ages 3.5, 4.5, or 5.5 years. Mean ages of the three groups were 3-7, 4-7, and 5-6. There were 16 males and 16 females in each age group. Subjects were selected from four schools, except that a fifth school provided six 3-year-old boys, as did a sixth school. The procedural design was 3 (age) x 2 (gender) x 2 (list) x 4 (treatment) with two subjects per cell.

Materials and apparatus

Studies which have used both words and pictures (or objects) have found that children recall pictures and objects better than words (cf. Corsini, Jacobus & Leonard, 1969). Sasser & Keenan (Note 2) found ceiling effects with recognition of pictures by preschool children, so spoken words were used for the present experiment. Words were members of four categories: animal, furniture, food, and vehicle. With the constraint that three words for each of the four classes appear in each list, items were randomly assigned to the A list or the B list. Many of the words had been used successfully in research with children of these ages (e.g. Davies & Brown, 1975). Parallel lists were used to provide a degree of generalization of results. The lists used are shown in Table 1.

Insert Table 1 about here

For the treatment called "semantic" children were to indicate category membership by pointing. A 15" x 15" board was divided into four quadrants, each containing three examples of one of the

categories. No example was on either target list. For the "schematic" treatment, two stories were written, each containing all the words from one list. The story for list A began, "In the great forest there lived a little ELEPHANT named Pierre." The parallel list B story began "In the great forest there lived a little BEAR named Suzanne." Each child heard only one of the stories. The word order established by the story scheme was used for all presentations. For the recognition test, corresponding A and B words were randomly assigned to first or second position, and pairs were presented in a random order.

The treatment called "episodic" required a set of probes to elicit personal associations from subjects. Three such questions were prepared for each word, e.g. "Did you ever see an elephant?", "Where did you see it?" and, "Were you afraid of it?" A practice trial consisting of CAR, BICYCLE, and AIRPLANE was used for all subjects. All subjects also performed the same distractor task between processing and recall, i.e. drawing a line through three circles on a 3 x 3 matrix of geometric forms.

Procedures

All data were taken by the same investigator, who met the children as they were introduced by the Director of the school. After getting acquainted, they began the "remembering game" with the practice trial. The task-by-list combinations were randomly assigned within age-by-gender combinations. The target words were then read by the experimenter and repeated by the child to ensure that every word was known by every subject. Following presentation of the twelve words, in the story order, the assigned processing task was completed, in the story order.

Episodic task. After hearing and repeating each word the child was asked a series of questions about each word ". . . because I think talking about them will help you to remember them." Each question was designed to activate episodic (autographical) associations, i.e. to relate a target word to personal episodes or events in the child's long-term storage. Some questions were more generic than episodic, e.g. "Do you put catsup on your hamburger?" Each question was nonetheless subjective, with first person reference, and fit the connotation of "episodic" as discussed by Nelson & Brown (1978).

Semantic task. This processing activity was focused on the category membership of each word. The child looked at the board with its four quadrants, and named the examples that appeared in each part. If the child did not spontaneously name the category, the investigator said whether the words were exemplars of food, animals, clothes, or furniture. The twelve target words were then read to the child, who was required to point to the appropriate quadrant.

Schematic task. The child was asked, in this treatment, to listen for the target words and remember them, as the investigator read the appropriate ELEPHANT or BEAR story, giving slight emphasis to target words as they occurred.

Repetitive task. This processing task was included principally as a control condition. The levels-of-processing literature is based almost completely on the premise that rote processing of words, even with intent to remember, is not conducive to recall (Craik & Lockhart, 1972). The words were heard and repeated by the child, in the story order, five consecutive times. The number of repetitions was

determined in pilot work to occupy the same amount of processing time as was required in the other tasks.

Following each word processing activity, the subject was asked to draw a line through three circles in a matrix of nine geometric forms. After this distractor task, intended to reduce recency effects, the subject completed tests of free recall, cued recall, and recognition. During free recall the child was reminded of the words repeated when asked to play the remembering game, and was asked to say all the words that could be remembered. When a subject stopped, the investigator prompted ". . . any more words?" Cued recall was a request for words by category, the experimenter saying the category name. The recognition test was a forced-choice list of randomly ordered A-B pairs.

Results

Dependent measures were free recall, cued recall and recognition of the to-be-remembered words. Also measured were processing-activity times, testing times, and errors. Data were analyzed to reveal associations of dependent variables with gender, running order and school attended, as well as age. Analyses also estimated effects of treatment, list learned and of item order. Principal results are summarized in Figure 1.

Insert Figure 1 about here

Free recall. This was the total number of correct responses to the request to recall, followed by a probe for "more" when production seemed to stop. Free recall increased with age, as expected,

$F(2,48) = 11.81$, $p < .01$. There was a reliable linear trend with age, $F(1,93) = 17.27$, $p < .01$. A Newman-Keuls test showed that the five-year-olds recalled more than the younger groups ($p < .05$). The processing tasks were differentially effective, $F(3,48) = 15.44$, $p < .01$, with rote repetition producing more recall than the other three tasks (Newman-Keuls, $p < .05$). In view of the levels-of-processing literature, this was a surprising outcome. Rote repetition by adults would not facilitate recall in comparison with any processing task which activated permanent semantic memory structures. Indeed, Posnansky (1978) found that kindergarten children reliably recalled more items when informed of category size or asked to estimate category size, than control subjects who were simply asked to recall items. Nonetheless, this processing task produced recall superior to every other task and at each age.

Cued recall. Following free recall, children were asked to give all the words that named animals, and so forth for the four categories. The target words evoked by these cues, which had not already been given in free recall, constitute the cued recall measure. Although total recall with cueing showed regular age increases in all conditions, the additional words given increased at chance levels only (In two of eight comparisons, the four-year-olds added more than did the five-year-olds.). Processing tasks contributed differently to the cued recall measure, $F(3,48) = 8.22$, $p < .01$. By Newman-Keuls test the episodic and schematic processors added more words than did the semantic and repetitive processors ($p < .05$). The repetitive subjects were doing rote processing, without any necessary attention to meaning, which would account for their inability to use category

cues. The semantic processors were expected specially to show facilitation from these cues, but there was apparently a strong interference from the pictures used in that processing activity. Nearly half the intrusive errors given by that group were names of pictures seen in the processing task, and it has been shown that pictures are more salient than words with young children from two to five.

Recognition. This test forced subjects to choose which member of an A-B pair had been seen earlier in the experiment. Words were ordered randomly within pairs and pairs were presented in random order. Recognition scores showed a linear increase with age, $F(1,93) = 48.30$, $p < .01$. Although Kail (1979) indicates that recognition memory is "nearly mature" in preschoolers, Myers & Perlmutter (1978) testify to the improvement of recognition in the years from two to five. More recently, Sophian & Stigler (1981) found improvement between kindergarten and first grade. These positions are compatible with one another and with the present data if we accept "nearly mature" to mean recognition is still improving, in contrast with deliberate recall which has just begun to appear. Sasser and Keenan (Note 2) found .98 accuracy in recognition of pictures by children from virtually the same pool as the subjects of the present study who showed only .79 accuracy. A part of this effect may be due to the youngest subjects, who showed a tendency to repeat the second member of each pair.

Recognition scores were affected also by processing task, $F(3,48) = 3.91$, $p < .01$. The episodic task and the repetitive task led to higher recognition than did the semantic and schematic tasks

(Newman-Keuls, $p < .05$). The particular procedures of this experiment apparently made the target words more distinct in the former tasks, whereas the latter tasks both induced memory traces involving many irrelevant words.

Ancillary results. Also measured was the time required for a child to complete the word processing activity--about six minutes. Time decreased with increasing age, $F(2,48) = 10.73$, $p < .01$, and varied with task, $F(3,48) = 39.00$, $p < .01$. The Newman-Keuls test showed that the episodic task took longer than the semantic and schematic tasks, and the repetitive task took the least time ($p < .05$). Because the episodic task, requiring more time, was also the more facilitative task in cued recall and in recognition, the retrieval measures were analyzed with processing time as a covariate. All the task effects remained statistically significant.

Testing time varied with task differences, the episodic and schematic conditions requiring more time than the repetitive and semantic conditions, $F(3,48) = 5.87$, $p < .01$. No explanation is offered, here, for this effect, but it invites closer inspection. Testing time was greater for list B than for list A, $F(1,48) = 5.44$, $p < .05$, but this appears to be the result of one subject who talked for nine minutes. Primacy and recency effects occurred in free recall even with a 20-second distractor task. There was not a difference between list A and list B on any retrieval measure. Boys and girls did not perform differently on any retrieval measure, though the girls did occupy more processing time, $F(1,48) = 4.59$, $p < .05$.

Discussion. Taken together, these several results imply at least three things about the mnemonic activities of preschool

children. They may be fruitfully studied using adult paradigms, the episodic-semantic distinction needs elaboration for children, and behavioral learning interacts strongly with cognitive processes at these ages.

Experimental paradigms and theoretical notions about memory and cognition have matured at a remarkable pace in the past two decades. As these procedures and models are adapted to children data become more expensive in terms of experimenter time and effort, but a variety of modifications of technique have made it practical to talk about recall and recognition of verbal encodings with school children and even with toddlers. Results must be interpreted carefully, however, because mean values may include scores for children who are unable or unwilling to follow instructions. Very young children may have greater difficulty differentiating list words from other words spoken during the session. Indeed, the probability of recalling one of the three practice words was .19 and the probability of recalling a target word was only .25; furthermore, the three-year-olds recalled proportionately more practice words than target words. Similarly, the names of things pictured for the semantic task were given 4.3 times more often than the mean free recall of target words, which was not quite three words for all conditions combined. The difficulty children had in reinstating the encoding context in this experiment was overcome in an experiment by Perlmutter et al. (1981) who had children give an item (line drawing on a card) to a Snoopy doll if it was a target item. This episodic reinstatement permitted comparison of contextual cues with semantic cues in a way that was more revealing than were the procedures of the present study.

The episodic-semantic dichotomy we have come to know and trust (Tulving, 1972) has been useful in suggesting many research hypotheses. But for the study of memory in little children, it is clear that "episodic" needs to be partitioned further into its autographical aspect (as in our episodic task), and its contextual aspect (as in the episodic reinstatement procedure of Perlmutter, et al.). Semantic memory also needs to be subdivided into its categorical aspect which is the abstraction of classes from things, and its schematic aspect which is the abstraction of scripts from particular temporal patterns of events. Perhaps our schematic subjects might have recalled more targets if the story itself were first recovered. A separate experiment is needed to determine the feasibility of the story context as a cue for verbal constituents with very young children.

The most striking result found was the superior recall by the repetitive processing subjects. This fact reminds us that children, with a growing repertoire of knowledge structures and mnemonic strategies, still need performatory practice. The behavioral aspect of saying the target words during processing as they will say them at recall was a powerful facilitator for these subjects. Although it was a surprise in the present investigation, the importance of rote repetition to young children should not be generally surprising.

Children spontaneously repeat words and phrases, more than they will a few years later; and highly repetitious passages are common in childrens bedtime stories, e.g., ". . . 'I'll do it myself' said the little red hen, and she did." Perhaps when proactive interference has accumulated in a person's life, organization is necessary, but at some earlier time, simple behavioral rote repetition should still be an

expected strategy of acquisition and recall, and an expected technique of instruction.

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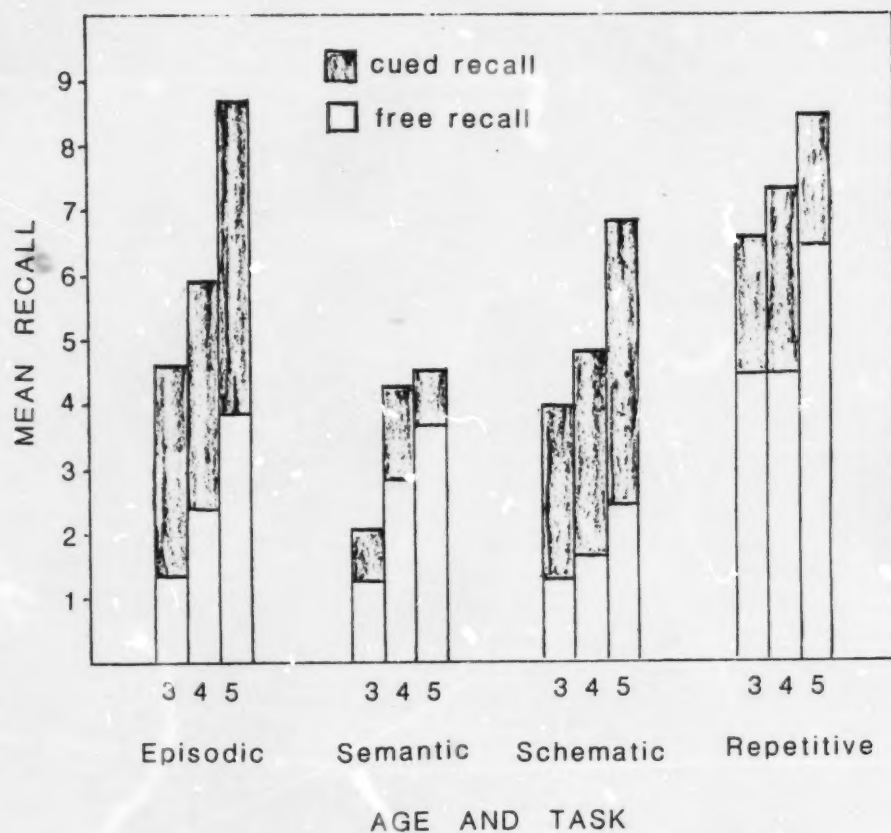


Figure 1. Mean target words produced in free recall and cued recall by age and processing-task groups.

TABLE 1
Target Words

Category	List A	List B
Animal	elephant tiger cat	bear lion dog
Food	hamburger french fries candy bar	hot dog potato chips ice cream
Furniture	couch table radio	bed chair T.V.
Clothing	sweater pants hat	dress coat shoes